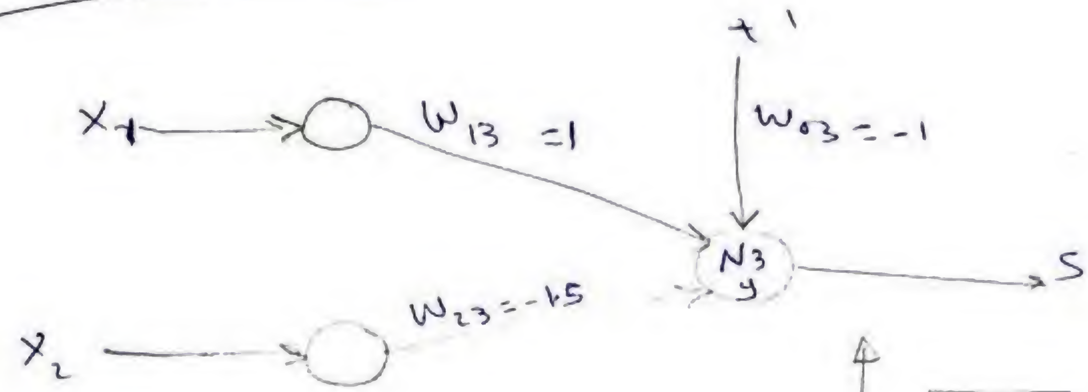
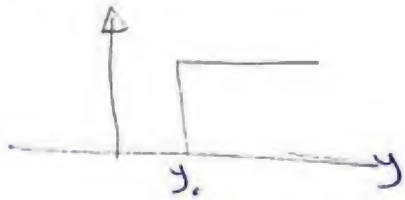
Neural Lec 5

Quiz sol





$S = x_1 + x_2'$

x_1	x_2	x_2'	S
0	0	1	1
0	1	0	0
1	0	1	1
1	1	0	1

$y = x_1 w_{13} + x_2 w_{23} + w_{03}$

$= x_1(1) + x_2(-1.5) - 1$

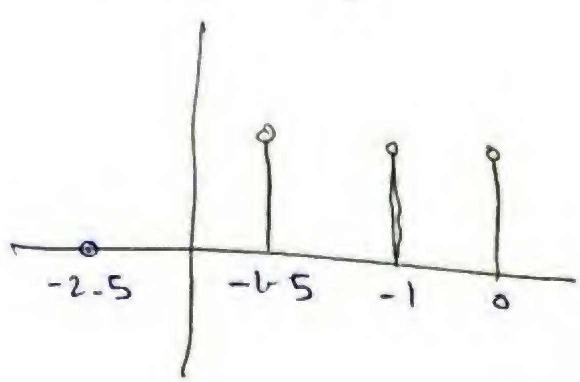
at $x_1 = x_2 = 0$

$y = -1 \longrightarrow S = 1$

at $x_1 = 1$ $\quad x_2 = 0$

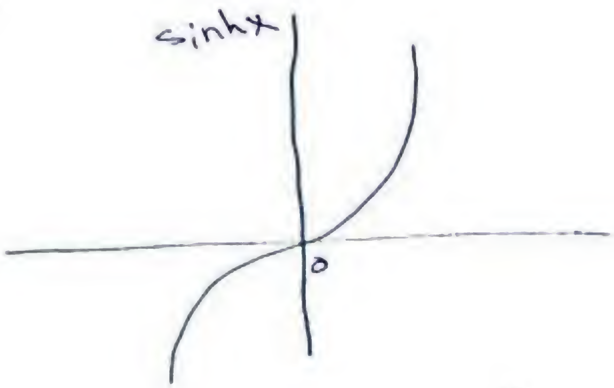
$y = -2.5 \longrightarrow S = 0$

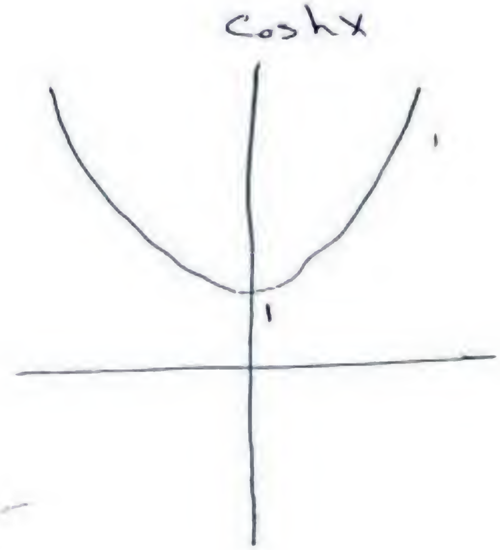
⋮



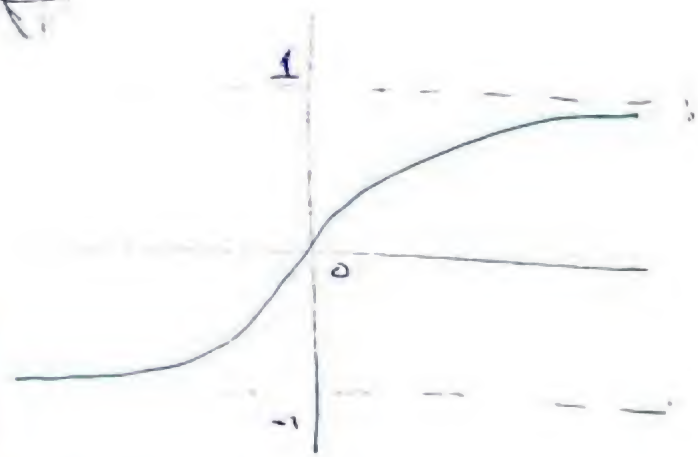
Hyperbolic tangent function (tanh)

$$\tanh = \frac{\sinh x}{\cosh x}$$





~~For a Pibolar sigmoidal function with $\alpha=2$~~



$$\boxed{\tanh x = \frac{2}{1+e^{-2x}} - 1}$$

~~Algbe~~ Hyperbolic tangent function is the same as a Pibolar sigmoidal function

$$g(x) = \frac{2}{1+e^{-2x}} - 1 \qquad (\alpha = 2)$$

$$\tanh\left(\frac{\alpha x}{2}\right) = \frac{2}{1+e^{-2x}} - 1$$

so the bipolar sigmoidal function $g(x) = \frac{2}{1+e^{-\alpha x}} - 1$

$\equiv$ hyperbolic tangent function of the form

$$\tanh\left(\frac{\alpha x}{2}\right)$$

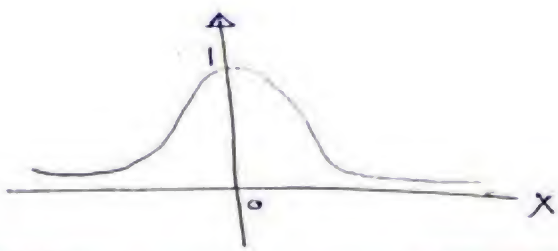
$$\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x = 1 - \tanh^2 x$$

$$\operatorname{sech}^2 x = 1 - \tanh^2 x$$

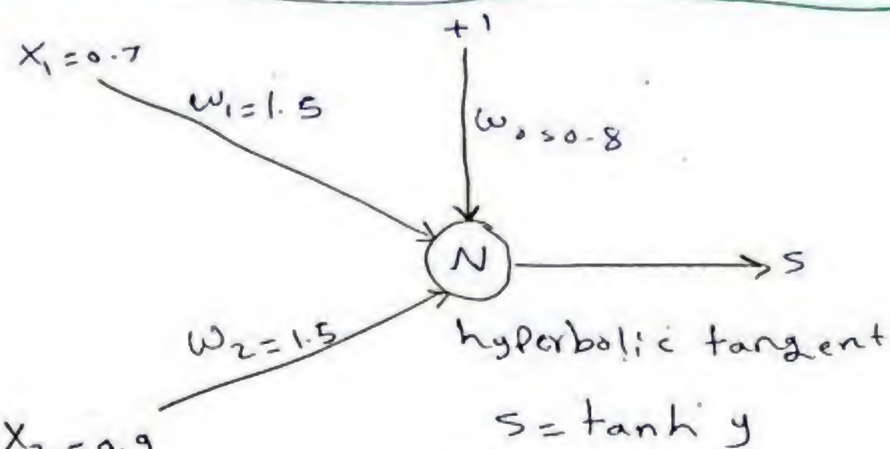
Let $\tanh x = s$, $x = y$

$$\frac{d}{dy}(s) = 1 - s^2$$

$$\operatorname{sech} x = \frac{1}{\cosh x}$$



$\boxed{Ex}$



Activation,

$$y = (0.7)(1.5) + (-1.5)(0.9) + 0.8 = 0.5$$

output signal, for a hyperbolic tangent function, $s = \tanh y = \tanh 0.5 = 0.462$

← إذا كانت w_1 , w_2 تم تثبيتها عند القيم
السابقة، بينما الـ (bias weight w_0) تم اعتباره Param.
للتصميم، أوجد قيمة w_0 إذا كانت الإشارة الناتجة 0.81

$$s = \tanh y \Rightarrow y = \tanh^{-1} s$$

$$s = 0.81 \Rightarrow y = 1.127$$

$$y = (0.7)(1.5) + (0.9)(-1.5) + w_0$$

$$\boxed{\therefore w_0 = 1.427}$$

→ find value of derivative of o/p signal with respect to the activation

$$s = \tanh y$$

$$\frac{ds}{dy} = \frac{d(\tanh y)}{dy}$$

$$\frac{ds}{dy} = \operatorname{sech}^2 y = 1 - \tanh^2 y$$

$$\frac{ds}{dy} = 1 - s^2 \qquad , \; s = 0.81$$

$$\boxed{\frac{ds}{dy} = 0.344}$$

* A neuron employs a hyperbolic tangent function under certain operating condition, the derivative of the o/p signal s with respect to the activation y is found to be 0.441, find y, s

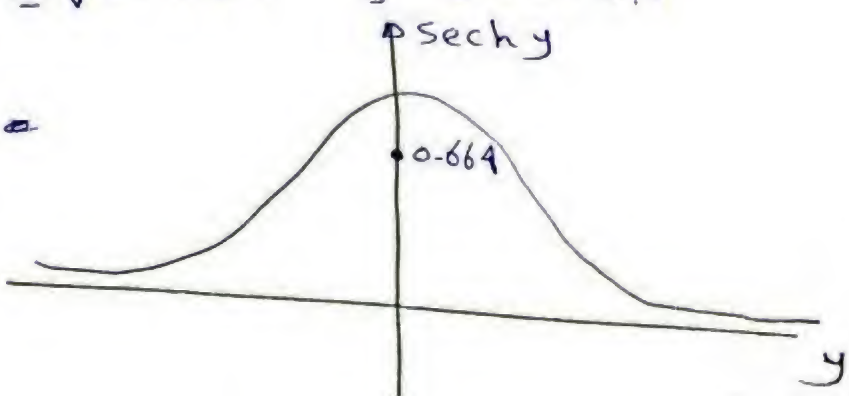
Sol.

$$s = \tanh y$$

$$\frac{ds}{dy} = \operatorname{sech}^2 y = 0.441$$

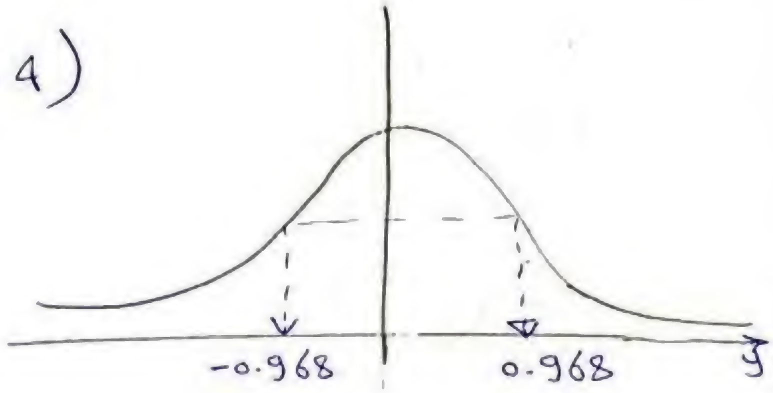
$$\operatorname{sech} y = \sqrt{0.441} = \pm 0.664$$

← السالب مرفوض
لأنه غير مترافق مع
المنحنى بتاع sechy



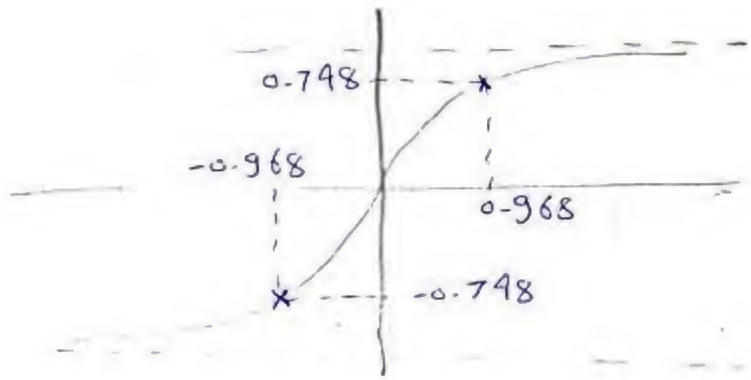
$$y = \operatorname{sech}^{-1}(0.664)$$

$$= \pm 0.968$$



$$s = \tanh y$$

$$s = \pm 0.748$$



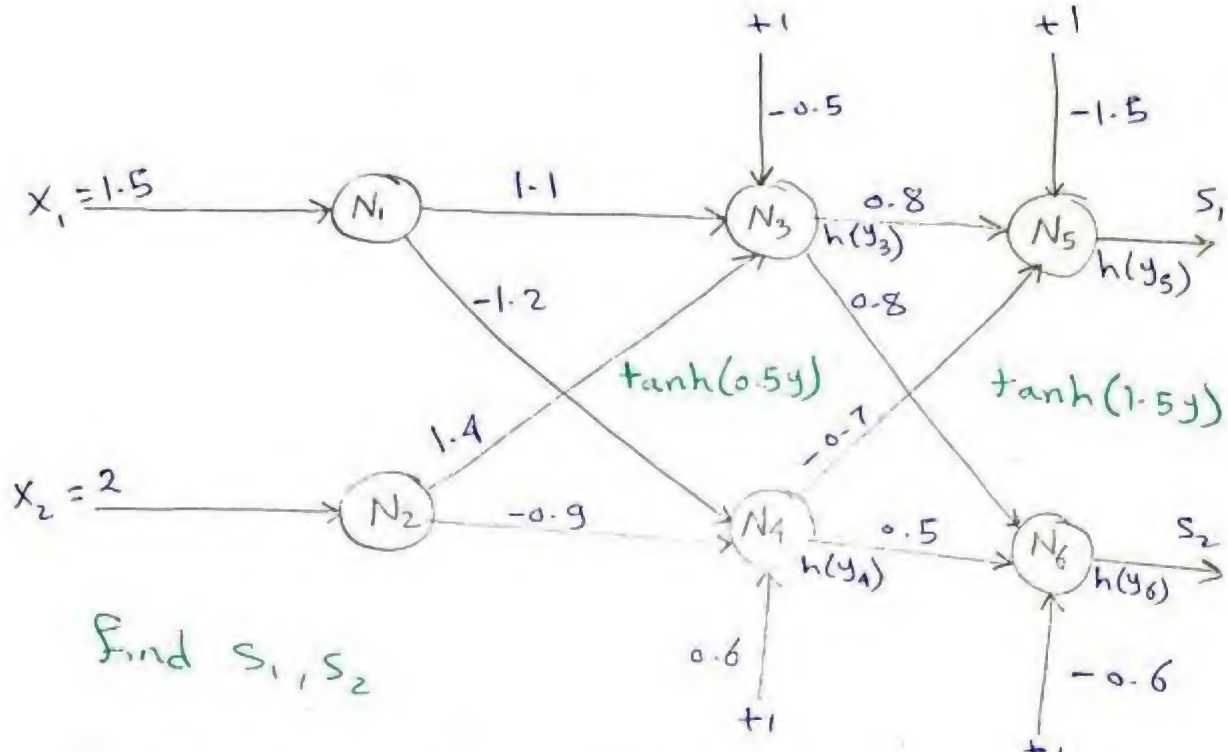
ويمكن حل هذه المسألة بطريقة أخرى كما يلي.

$$s = \tanh y \quad ; \quad \frac{ds}{dy} = 1 - \tanh^2 y = 0.441$$

$$\tanh y = \sqrt{1 - 0.441} = \pm 748$$

$$y = \tanh^{-1} s = \tanh^{-1}(\pm 0.748)$$

$$= \pm 0.968$$



Find S_1, S_2

For hidden layer (hyperbolic) $\rightarrow \alpha = 0.5$

For output " (") $\rightarrow \alpha = 1.5$

<u>For hidden neuron N_3 $(\alpha = 0.5)$</u>

Activation,

$$y_3 = (1.5)(1.1) + (2)(1.4) - 0.5 = 3.95$$

output,

$$h(y_3) = \tanh(0.5\, y_3) = 0.962$$

For hidden neuron N_4 ($\alpha = 0.5$)

Activation,

$$y = 2(-0.9) + (1.5)(-1.2) + 0.6 = -3$$

output,
$$h(y_4) = \tanh(0.5\, y_4) = -0.905$$

For output neuron N5 ($\alpha = 1.5$)

Activation,

$$y_5 = (0.962)(0.8) + (-0.905)(-0.7) - 1.5 = -0.097$$

output,
$$S_1 = h(y_5) = \tanh(1.5\, y_5) = \boxed{-0.144}$$

For output neuron N_6 ($\alpha = 1.5$)

Activation,

$$y_6 = (0.962)(0.8) + (-0.905)(0.5) - 0.6$$

$$= -0.283$$

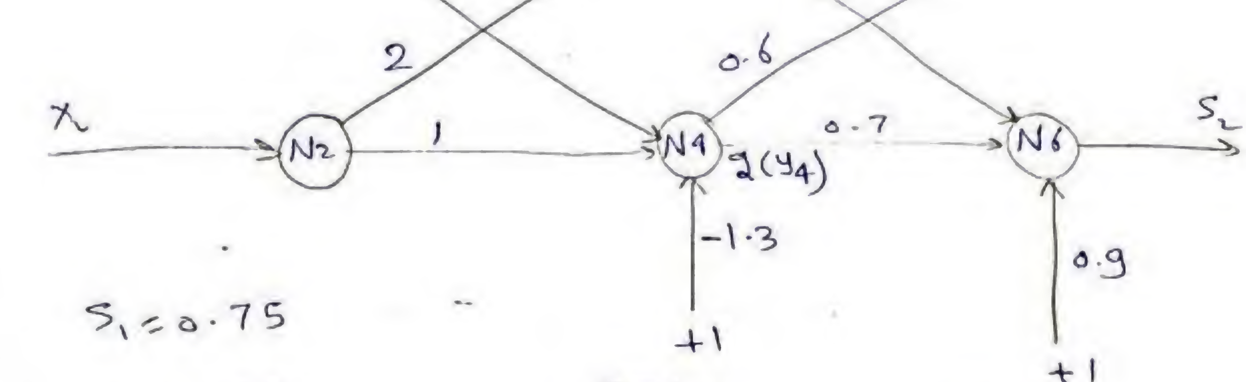
output,

$$h(y_6) = S_2 = \tanh(1.5\, y_6) = -0.401$$

لم نستطيع في كثير من الأحوال أنه نوجد قيم ال (o/ps)
للشبكة لمعرفة ال (i/ps)

→ Given the outputs of a neural network, find the inputs,

→ In the two-input, two output neural ~~neural~~ network shown, the hidden neurons employs bipolar sigmoidal functions while the output neurons employ binary sigmoidal functions, if the outputs are measured as $S_1 = 0.75$, $S_2 = 0.58$ find inputs X_1, X_2



$S_1 = 0.75$

$S_2 = 0.58$

Bipolar sigmoidal

Binary sigmoidal

output layer (N_5 , N_6)

Binary sigmoidal

N_5 :

$$y_5 = Ln \frac{S_1}{1-S_1} = 1.099$$

N_6 :

$$y_6 = Ln \left(\frac{S_2}{1-S_2}\right) = 0.323$$

$$y_5 = (0.5)\, g(y_3) + (0.6)\, g(y_4) + 0.8 = 1.099$$

$$\boxed{0.5\, g(y_3) + 0.6\, g(y_4) = 0.299} \longrightarrow (1)$$

$$y_6 = (-0.5)\, g(y_3) + (0.7)\, g(y_4) + 0.9 = 0.323$$

$$\boxed{-0.5\, g(y_3) + 0.7\, g(y_4) = -0.577} \rightarrow (2)$$

solve 1 , 2

$g(y_3) = 0.855$, $g(y_4) = -0.214$

← تنتقل الآن الى ال (hidden layer) فابقوا معنا.

$$y_3 = Ln\left[\frac{1 + g(y_3)}{1 - g(y_3)}\right] = 2.549$$

$$y_4 = Ln\left[\frac{1+g(y_4)}{1-g(y_4)}\right] = -0.435$$

$$y_3 = -x_1 + 2x_2 - 2 = 2.549$$

$$\boxed{-x_1 + 2x_2 = 0.549} \longrightarrow (a)$$

$$y_4 = \cancel{x} - x_1 + x_2 - 1.3 = -0.435$$

$$\boxed{-x_1 + x_2 = 0.865} \longrightarrow (b)$$

Solve (a) & (b)

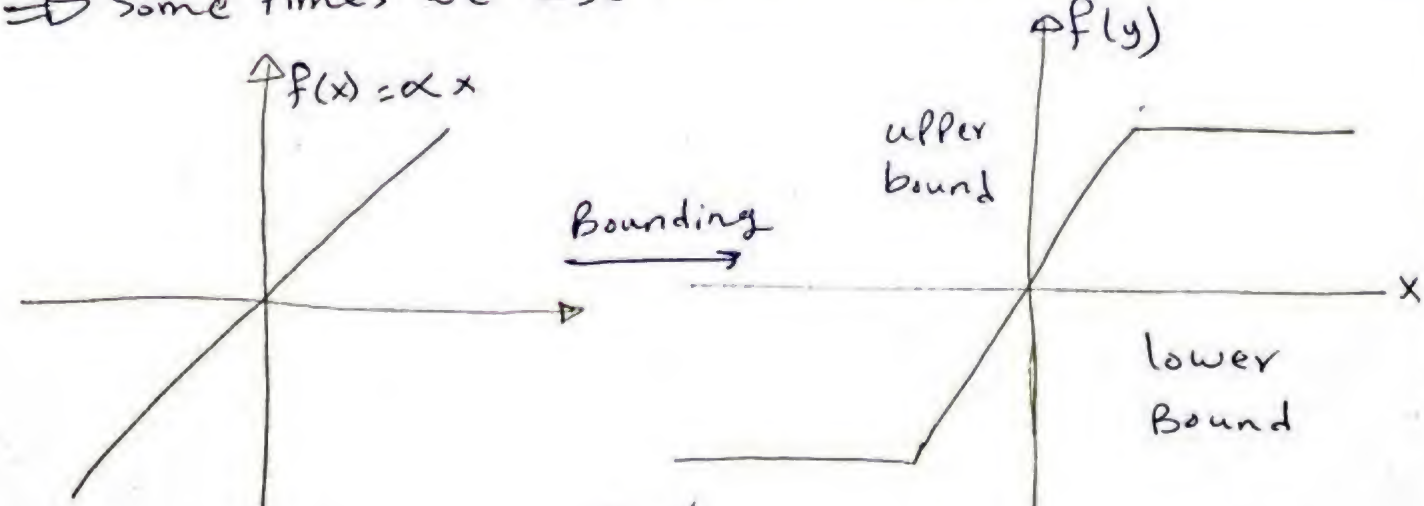
$x_1 = 2.819$ & $x_2 = 3.684$

~~Ex~~ Summary

Input $\rightarrow$ output (forward path) $\rightarrow$ input-hidden-output

output $\rightarrow$ input (backward path) $\rightarrow$ output-hidden-input

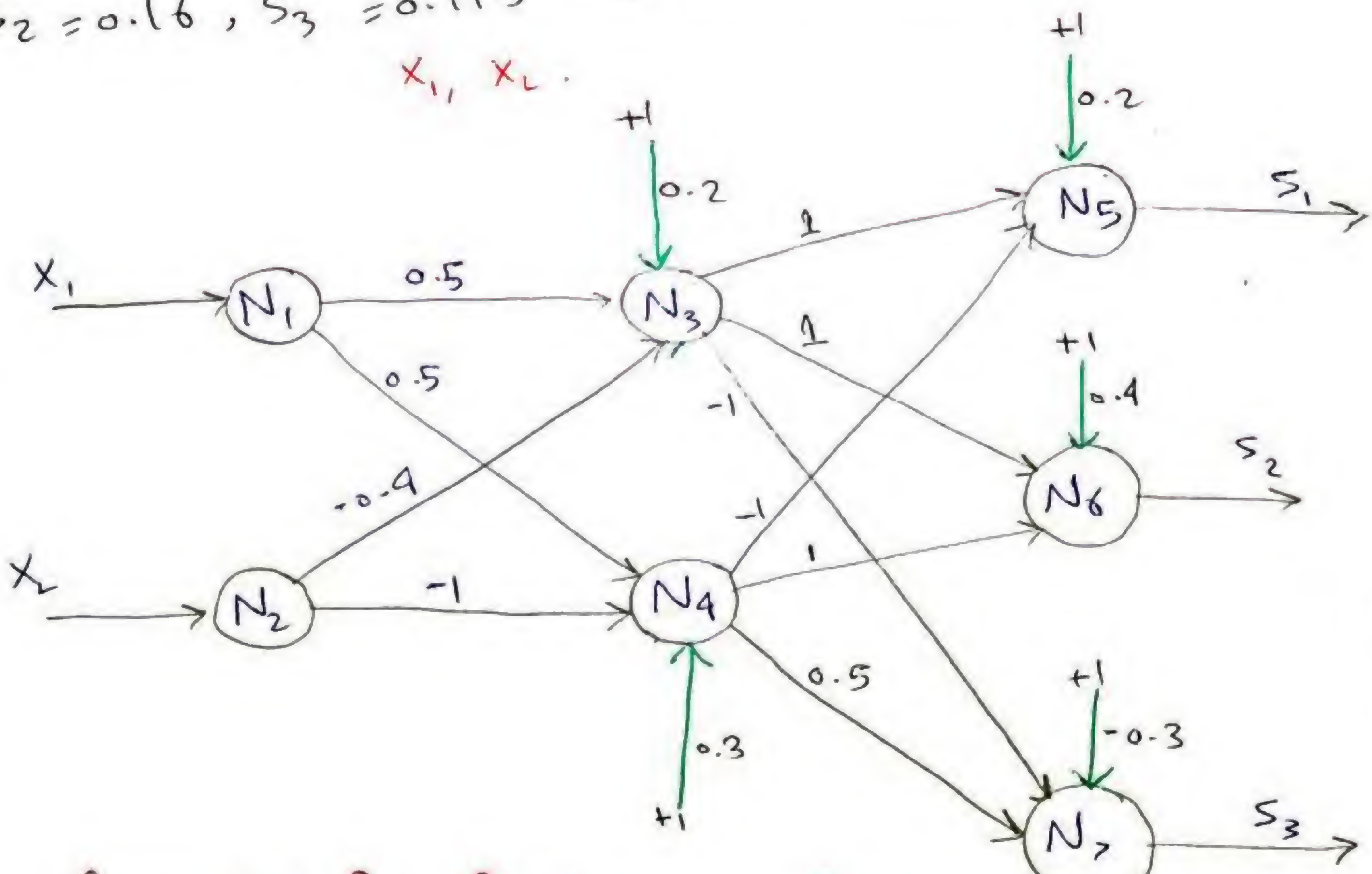
$\Rightarrow$ Some times we use linear function for activation



$\boxed{\text{EX 7}}$

Consider the two-input, three output neural network shown. The hidden and output neurons employ linear functions of the form $f(x) = \alpha x$, with $\alpha = 0.2$ for each hidden neuron and $\alpha = 1$ for each output neuron.

if the outputs are found to be $S_1 = 0.22$, $S_2 = 0.16$, $S_3 = 0.115$ determine the inputs X_1, X_2.



Linear Act. Fn $f(x) = 0.2x$, $f(x) = x$

outputs of the network

$$S_1 = f(y_5) = y_5 = 0.22$$

$$S_2 = f(y_6) = y_6 = -0.16$$

$$S_3 = f(y_7) = y_7 = 0.115$$

Activation of the output neurons,

$$y_5 = (1)\, f(y_3) + (-1)\, f(y_4) + 0.2 = 0.22$$

$$\boxed{f(y_3) - f(y_4) = 0.02} \rightarrow (1)$$

$$y_6 = (1)\, f(y_3) + (1)\, f(y_4) + 0.4 = -0.16$$

$$\boxed{f(y_3) + f(y_4) = -0.56} \rightarrow (2)$$

$$y_7 = (-1)\, f(y_3) + (-0.5)\, f(y_4) - 0.3 = 0.115$$

$$\boxed{f(y_3) + 0.5\, f(y_4) = -0.415} \longrightarrow (3)$$

لدينا ٣ معادلات في مجهولين ، وإذا كانت هذه المعادلات مستقلة عن بعضها البعض رياضياً لا يوجد حل.

عدد المعادلات > عدد المجاهيل

ولكن بما أن الشبكة تعمل في ظروف معينة فلابد ألا يكون

هناك فى مواصفات الشبكة أى تعارض رياضى أو فيزيائى أو منطقى وبالتالى فإننا ~~ال~~ نتوقع أن المعادلات السابقة هى فى الواقع معادلتان (والمعادلة الثالثة معتمدة عليهما) هذا يعنى أنه يكفى لإيجاد المجهولين

$f(y_3), f(y_4)$ ← معادلتين فقط من المعادلات الثلاثة ~~وحل~~ وسنجد أن النتيجة تحقق تلقائياً المعادلة الثالثة.

← ~~نحل~~ هنحل معادلتين (1، 2)

$f(y_3) = -0.27 \quad , \quad f(y_4) = -0.29$

تحقق من أن هاتين القيمتين تحققان المعادلة رقم ٣.

Activations of the hidden neurons,

$$y_3 = \frac{f(y_3)}{0.2} = -1.35 = 0.5X_1 - 0.4X_2 - 0.2$$

$$\boxed{0.5X_1 - 0.4X_2 = -1.15} \longrightarrow (a)$$

$$y_4 = \frac{f(y_4)}{0.2} = \frac{-0.29}{0.2} = -1.45$$

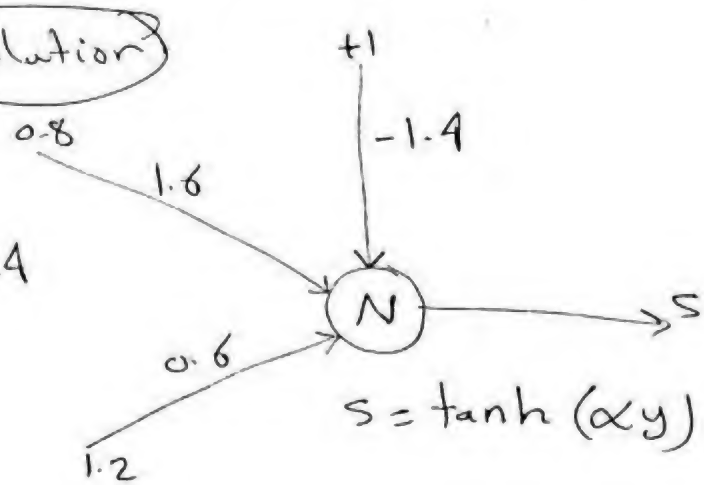
$$= 0.5X_1 - X_2 + 0.3$$

$$\boxed{0.5X_1 - X_2 = -1.75} \longrightarrow (b)$$

Solve $a, b \Rightarrow X_1 = -1.5 \quad , \quad X_2 = 1$

* A single neuron receives two inputs $X_1 = 0.8$ and $X_2 = 1.2$ with weights $w_1 = 1.6$, $w_2 = 0.6$ respectively, the bias weight is $W_0 = -1.4$
The neuron employs a hyperbolic tangent function of the form $s = \tanh(\alpha y)$, where s is the output signal, y is the activation, and α is a positive parameter.
The derivative of s with respect to y is found to be 0.311.
Calculate the values of α, y and s

Solution



Activation,

$$y = (0.8)(1.6) + (1.2)(0.6) - 1.4$$
$$= 0.6$$

Derivative,

$$\frac{ds}{dy} = \alpha \operatorname{sech}^2(\alpha y)$$

$$= \alpha \left[1 - \tanh^2(\alpha y)\right] = 0.311$$

$$\tanh^2 (0.6\,\alpha) = 1 - \frac{0.311}{\alpha}$$

← يمكننا حل المعادلة السابقة برسم منحنى للطرف الأيسر ومثله للطرف الأيمن ونقطة تقاطعهما تحدد (α) التي تحدد المعادلة.

α	1	2	3	4	5	6	... ∞
$\tanh 0.6\alpha$	0.288						1
$1 - \frac{0.311}{\alpha}$	0.689						1

$\alpha = 3$

<u>output signal</u>

$S = \tanh(0.6\ X_3)$

$= 0.947$